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At Landstuhl Army Regional Medical Center (LARMC), the increase in the number of inpatients due to Operations Desert Shield and Desert Storm had made leaders acutely aware of efficiency issues throughout the facility. One key area targeted for improvement in efficiency was bed utilization management. Leaders at LARMC were convinced that their bed utilization management practices were not fully efficient, and were eager to improve them in the face of the potential for a dramatic rise in the number of inpatients presented by the situation in the Persian Gulf Region. As a topic in current professinoal literature, bed utilization management is not well established. Much of what has been written about improving efficiency in this area can be classified into the following categories: bed utilization, nursing resource management, patient classification systems, and expert systems applications to nursing and bed management. Approaching the problem from the above-mentioned perspectives, I set out to investigate the feasibility of using an expert system to improve LARMC's bed utilization efficiency. My investigation began with an assessment of the effectiveness of the current bed utilization

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management efforts, and a determination of the system objectives desired by the stakeholders. I explored the applicability and feasibility of existing automated systems and evaluated the current system's ability to meet those objectives. Based on my findings, I developed an expert system which incorporated applicable portions of the current system and filled identified shortfalls to accomplish desired goals. The final product, a patient placment decision support model, was designed to incorporate stakeholders' expertise in meeting their goals. Use of the model should enable LARMC to experience greater efficiency in bed utilization management.

BED UTILIZATION MANAGEMENT AT LANDSTUHL ARMY REGIONAL MEDICAL CENTER: DEVELOPMENT OF A PATIENT PLACEMENT DECISION SUPPORT MODEL

A Graduate Management Project

Submitted to the Faculty of

Baylor University

In Partial Fulfillment of the

Requirements for the Degree

of

Master of Health Administration

by

Captain Peter T. Shaul, MS

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Abstract

At Landstuhl Army Regional Medical Center (LARMC), the increase in the number of inpatients due to Operations Desert Shield and Desert Storm had made leaders acutely aware of efficiency issues throughout the facility. One key area targeted for improvement in efficiency was bed utilization management. Leaders at LARMC were convinced that their bed utilization management practices were not fully efficient, and were eager to improve them in the face of the potential for a dramatic rise in the number of inpatients presented by the situation in the Persian Gulf Region.

As a topic in current professional literature, bed utilization management is not well established. Much of what has been written about improving efficiency in this area can be classified into the following categories: bed utilization, nursing resource management, patient classification systems, and expert systems applications to nursing and bed management.

Approaching the problem from the above-mentioned perspectives, I set out to investigate the feasibility of using an expert system to improve LARMC's bed utilization efficiency. My investigation began with an assessment of the effectiveness of the current bed utilization management efforts, and a determination of the system objectives desired by the stakeholders. I explored the applicability and feasibility of existing automated systems and evaluated the current system's ability to meet those objectives.

Based on my findings, I developed an expert system which incorporated applicable portions of the current system and filled identified shortfalls to accomplish desired goals.

The final product, a patient placement decision support model, was designed to incorporate stakeholders' expertise in meeting their goals. Use of the model should enable LARMC to experience greater efficiency in bed utilization management.

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Introduction

The commander of Landstuhl Army Regional Medical Center (LARMC) was concerned that his institution was not efficiently using its physician manpower, nursing manpower, and available physical assets in its bed utilization management efforts. As patients were admitted to the facility, they were assigned to wards via a manual system which did not fully address nurse and physician productivity, nor did it fully explore the possible combinations of resources available to achieve the most efficient combination. This system was time consuming and required close coordination between nursing supervisors and the many admitting physicians throughout the facility.

Prior to the summer of 1990, LARMC staff conducted bed utilization management by using a decentralized manual process. An admitting physician would call the head nurse on each ward until he/she found a ward which would accept the patient. Nursing supervisors acted in a mediating role, providing liaison between the physician and nursing staffs. There was no official conflict resolution channel, so any problem was handled directly between the aforementioned parties.

During this period, LARMC experienced a severe shortage in nursing personnel, while patient acuity levels and census remained stable. Concerns over inefficient bed utilization and unequal use of nursing resources across wards became intense after Iraq invaded Kuwait on 2 August, forcing the hospital to begin planning for wartime casualties. In response to the heightened concerns, the Deputy Commander for Clinical Services (DCCS) began a series of actions designed to improve efficiency and correct perceived problems in the hospital's bed utilization management system.

On 10 August 1990, a special meeting of the hospital's Utilization Review Committee was called to discuss bed utilization. At that meeting, several concepts were introduced to the committee. The Workload Management System for Nursing (WMSN) was discussed as an internal mechanism for managing nursing resources and beds. Although WMSN was designed as a staffing resource tool and was implemented by the Army Medical Department (AMEDD) in 1985, formal recognition and adoption of the system by members of LARMC outside the Department of Nursing had not yet occurred. Another concept discussed was that of setting acuity thresholds on each ward to identify their respective ability to handle more admissions. Tentatively named "warning" and "capping" levels, these thresholds would be set uniformly across wards, and would serve to identify the relative balance between the care hours required by patients on a ward (Required Nursing Care Hours, or RNCH) and the care hours that ward's staff was able to support (Supportable Nursing Care Hours, or SNCH). These thresholds would be communicated to physicians, who would adjust their admissions accordingly.

Shortly following the meeting, the hospital published an official memorandum establishing policy and guidance for bed utilization management. The memorandum established WMSN as an official guide in bed utilization management, and outlined responsibilities of ward officers and head nurses. The memorandum vaguely set a "warning" threshold of RNCH = 1.2 SNCH, and discussed the procedure for declaring a ward "capped."

By September, the growing number of patients from Operation Desert Shield complicated the bed utilization management efforts taken previously. Patients were arriving in large groups, necessitating a bulk admissions process directed by a single physician. The DCCS tasked this physician with managing the admissions process for patients from the Southwest Asian (SWA) Theater of Operations, and gave him approval authority over the elective surgery list. The DCCS further instructed the night nursing supervisors to report their regular audits of SNCH and RNCH figures to the physician. Armed with this authority and information, the admissions physician would be able to regulate admissions from SWA and make appropriate patient placement decisions.

Another meeting of the Utilization Review Committee was held on 25 October 1990 to discuss further complications in the bed utilization management efforts taken to date. Among the most significant problems was the inability of the various reporting systems to capture the changing and very fluid nature of the bed status information. WMSN data was prepared daily at 1400, as required by standard practice, and was reported through the nursing supervisors to the admissions physician. The nature of the medical evacuation system caused a large proportion of our patients to arrive during the evening and nighttime hours, causing a significant change to bed status information by the next morning.

During the October meeting, the DCCS ordered a Bed Utilization Committee to form as a subcommittee of the Utilization Review Committee. He designated the following as members of the new Bed Utilization Committee: DCCS, Chief Nurse, the chiefs of the major admitting services (Medicine, Surgery, Pediatrics, Obstetrics & Gynecology, and Psychiatry), the nursing supervisors, the assigned ward officers, the head nurses from each ward, and the Administrative Resident.

In November, the DCCS introduced another development into the bed utilization management process. He appointed three physicians to replace the admissions physician and to provide 24 hour coverage on a rotating basis. Giving them the title "Patient Traffic

Control Agent", or PTCA, he tasked these physicians to monitor all admissions into the hospital. Reaffirming WMSN as an internal management tool, he directed the nursing supervisors to report bed status information to the PTCA on duty (affectionately referred to as the "Pizza-man"). He also gave the PTCA approval authority for all elective admissions.

Despite these efforts, inefficiencies still exist. Concurrent overutilization and underutilization of wards, uncoordinated admissions, and significant time lags in bed status information persist. The large amount of time senior staff members spend each day in managing these efforts is perhaps the most significant example of inefficiency.

Problem Statement

Leaders at Landstuhl Army Regional Medical Center seek to improve the efficiency of their bed utilization management efforts by increasing the coordination between the nursing staff and admitting physicians, while decreasing the man-hours required to manage the process.

Literature Review

The literature I researched has indicated that automated bed utilization programs, especially those using expert systems, are not commonplace. Examples of automated and expert system applications were evident in patient assessment and nursing management, indicating a large body of knowledge and practice in these areas. However, information regarding patient assessment, nursing management, and bed utilization was generally independently developed and was not integrated.

My approach has led me to research literature in four general topic areas: 1. bed utilization management, 2. nursing resource management, 3. patient classification schemes, and 4. expert systems applications to nursing and bed management.

Bed Utilization Management

Because of the new reimbursement incentives placed on healthcare institutions, the efficient and effective use of resources is being emphasized now more than ever (Walters & Lincoln, 1987). New competitive pressures resulting from prospective payment, cost-containment programs, and the growth of Health Maintenance Organizations (HMOs) and Preferred Provider Organizations (PPOs), have forced hospital administrators to significantly improve efficiency to maintain the financial viability of their institutions (Restuccia, Payne, Lenhart, Constantine, & Fulton, 1987). Since inpatient care accounts for the majority of hospital costs, and because physicians control approximately 70% of the dollars spent on inpatient care, maximizing the efficiency of physicians' use of inpatient services is highly desirable. One of the primary ways to accomplish this is through a bed utilization management strategy.

The achievement and maintenance of effective bed utilization is most often confounded by problems with overutilization or underutilization. Also, it is not uncommon for a hospital to be overutilized in some services while underutilized in others. This problem of mixed utilization is more difficult to solve when the hospital in question is large, and when nondistinct beds are not logistically practical (Dumas, 1985).

Bed utilization can be addressed from three areas: bed allocation, patient placement, and admissions control (Dumas,1985). Bed allocation deals with the number and type of beds assigned to each service. Beds can be classified as private, semiprivate, division, or critical care. Swing beds are beds which can assume more than one configuration. Although it seems to offer great flexibility in bed allocation, use of the swing bed concept is limited by legislation to rural hospitals (Henderson & Moomaw, 1986).

A patient placement policy determines which patients can be placed in which beds. Along with their strong effect on utilization, patient placement rules make a significant statement about the hospital's patient management philosophy. In the extremes, policies can make little or no distinction among beds, or can permit virtually no exceptions to the rule that patient type and bed type must match. A more moderate policy is one in which strong bed-typing is countered with off-type placements. High utilization is easiest to achieve and maintain in the hospital with few bed distinctions, due to the great flexibility in bed usage (Dumas, 1985).

Admissions control defines how elective admissions are arranged and how waiting lists are managed. Patients are admitted to hospitals in a variety of ways: as elective admissions with pre-scheduled specific admission dates, as urgent and emergent cases from waiting lists, and as emergency cases appearing with no prior notice. Patients are brought in by attending physicians and by residents via outpatient clinics and the Emergency Room. They are classified by admission diagnosis as belonging to one of more than twenty services possibly available.

Dumas (1985) cites three common measures used to assess bed utilization effectiveness: percent occupancy, average daily census, and annual patient days. In the model developed for Mount Sinai Hospital, he included two other measures: misplaced patients and misplaced patient days. He also includes measurement of a number of other aspects of performance as secondary measures of effectiveness such as requests, bookings, refusals, list removals, and transfers.

Restuccia et al. (1987) measured efficiency of bed usage by identifying percentages of inappropriate admissions and inappropriate patient days, using an instrument called the Appropriateness Evaluation Protocol. They identified premature admissions, the lack of requirement for institutional care, and the requirement for lower-level care only as the reasons for inappropriate admissions. They identified the following as reasons for inappropriate days of care: the lack of requirement for further institutional care, the requirement for lower level care instead of the institutional care, and the requirement for continued hospitalization. The authors identified the physician or the hospital as responsible for 75% of the inappropriate days of care (13% environmental, 4% family, 8% undetermined).

Dumas (1985) highlights another class of measurements of bed utilization effectiveness: opportunity costs. Although impossible to measure these costs directly, they can be applied to patients in terms of the impact of events such as waiting, refusals, and improper placement.

Various authors have dealt with the subjects of efficiency and effectiveness measures of bed utilization in a number of ways. The literature at the aggregate level emphasizes regional bed requirements in areawide assessments, and total hospital requirements in community needs assessments. However, many models and procedures for establishing appropriate hospital bed levels and for controlling admissions have also been developed. Most of the earlier work is not practical in terms of implementation because many broad assumptions (such as "a bed is a bed" mentality) are made, not enough procedural detail (such as a variety of admission and patient types) is incorporated, and too many interactions (such as interservice transfers and off-service placements) are omitted (Dumas, 1985).

Other authors have dealt with the areas of bed usage, admissions procedures, and demand analysis by investigating various aspects of control of bed occupancy through the following: demand management, use of nonassigned swing beds in coping with fluctuations in service demand, methods of translating forecasts of demand into bed requirements, and the relationship of bed availability to daily discharge patterns. Pendergast and Vogel (1988) addressed the bed usage and admission procedures problem by developing a model which included the use of a repository for the placement of patients judged to require nonhospital locations of care. Martin, Dahlstrom, and Johnston (1985) addressed demand analysis by evaluating the impact of administrative technologies on the number of acute care beds required. Other authors have developed models and computer-aided admissions systems aimed at improving bed utilization through admissions control.

A simulation model designed to evaluate the effectiveness of bed allocation, usage, and admission policies was developed by M. Barry Dumas for the Mount Sinai Hospital in New York City. Written in Simscript 2.5 programming language, the model incorporated the distinguishing features of the hospital. The (Dumas) model generates and identifies individual patients by diagnosis category, sex, admission type, and time of demand. It distinguishes private, semiprivate, division, and critical care beds and classifies admissions by type: elective, urgent, emergent, and emergency. The model also identifies and assigns individual beds by service, accommodation type, and patient gender.

Nursing Resource Management

In order for bed utilization management strategies to work, managers must understand that a bed is not "a bed" until it is appropriately staffed and resourced. In this view, nursing resource management plays an integral part in bed utilization.

Nursing resource management has existed in various forms since the New York Academy of Medicine's study of institutional nursing in 1922 (Kirby, 1986). Emphasis has shifted from guidelines on the average nursing hours required per day for patients in the 1930s, to the appropriate use of auxiliary personnel in the 1940s, to patient classification systems and staffing methodologies in the 1970s and 1980s (Kirby, 1986). With the current emphasis on prospective payment, reducing costs per inpatient stay is perhaps the dominant issue of the 1990s.

Nurse staffing levels directly affect the quality and cost of inpatient care (Flood & Diers, 1988). In a study conducted by Flood and Diers (1988), nurse staffing levels were tested for their effects on patient complications, acuity levels, length of stay, and costs. The study found that adequate nurse staffing reduced the rate of complications, lowered acuity levels, and reduced length of stay, thus lowering costs.

Nurse staffing studies seek to determine that "adequate" level by establishing a system that balances the nursing staff available on each unit for each shift with the manpower required, according to the number of patients and their care needs (Vaughan & MacLeod, 1980). In current practice, the nurse administrator decides the staffing mix of professional and paraprofessional nursing personnel within established budgetary and human resource guidelines. This mix not only reflects the administrator's philosophy regarding quality of care, but reflects the cost and quality of care provided by the institution (Adams & Johnson, 1986).

An integral task in nurse staffing studies is the development of criteria for classification of patients according to the amount and type of care they need. The resultant acuity classification systems are used to measure the volume of work activity being performed on different types of patients by different types of personnel at various times of the day (Vaughan & MacLeod, 1980). Because the schemes for classifying patients vary among hospitals, and because the workload analysis systems are generally too tailored to individual institutions, comparisons to other hospitals and to nationwide norms are difficult. These results have led authors such as Vaughan and MacLeod (1980) to declare that nursing staffing studies have progressed little since the earliest research on the subject was conducted in the 1960s.

A joint effort by the U.S. Army Nurse Corps and the U.S. Navy Nurse Corps has provided significant progress in standardizing patient acuity classification and nursing workload management. Called "the Workload Management System for Nursing" (WMSN), this information system was designed to determine staffing requirements based upon patient care needs (Headquarters, Department of the Army [HQ,DA], 1990). Implemented in 1985, the WMSN incorporates a patient classification system, identifies nursing workload based on patient acuity, and provides guidelines for effective and efficient allocation of nursing staff (Vail, Norton, & Rimm, 1984).

Based on extensive time-and-motion studies, the WMSN patient classification system uses a factor evaluation design instrument which requires a nurse rater to assess 10 weighted factors relating to each patient, and to determine a point value for each factor. The points are totaled, and the patient is classified into one of six discrete acuity categories. The patient's resulting acuity classification is translated into a figure representing the hours of nursing care he/she will require. The figure is referred to as "required nursing care hours" (HQ,DA, 1990).

The WMSN identifies nursing workload based on patient acuity by employing a staffing methodology to determine the actual hours of nursing care and particular personnel mix required by the number of patients on a given ward. The system also determines the number of nursing care hours a particular mix of personnel can provide. This figure is referred to as "supportable nursing care hours" (HQ, DA, 1990).

The primary outcome of the WMSN is an estimate of the required nursing care hours (RNCH) of the patients on a ward and the number of supportable nursing care hours (SNCH) available from the staff on that ward. This estimate can be used as a guideline for effective and efficient staff allocation (Ward, Schoomaker, & Turner, 1991).

Patient Classification Schemes

As discussed previously, bed utilization management strategies rely on accurate nursing resource staffing management practices. Patient classification is the heart of any staffing workload analysis system (Vaughan & MacLeod, 1980). Patient classification is the grouping or categorizing of patients according to some predetermined set of characteristics (Giovannetti, 1985). They are used to quantify patient needs and determine nursing staffing necessary to meet those needs (Ambutas, 1987).

Patient classification schemes can be divided into two groups: primary and secondary. Some of the current literature refers to these as "prototype" and "factor evaluation" respectively (Ambutas, 1987). Primary classifications include schemes based on sociodemographic variables, disease entities, client problems, acuity, and dependency levels. Secondary classification schemes differ from primary schemes in that they employ a weighting scale and assign a unique value to each category of patient (Giovannetti, 1985). The two most common secondary patient classification schemes are Diagnostic Related Groups (DRGs) and Nursing Workload Measures.

The DRG classification scheme is designed to establish a price per hospital stay. The nursing workload measures classification scheme is designed to establish nursing care time requirements per shift or per day (Giovannetti, 1985). Many classification systems are specifically tailored towards a subset of patients. An example of these limited systems is the APACHE (Acute Physiology and Chronic Health Evaluation) system (Rosko, 1988). Other general patient classification systems include: Disease Staging, Severity of Illness Index, and Patient Management Categories. These general systems can define more clinically meaningful alternatives to DRG categorizations, and they can establish expected resource utilization standards (Batchelor, Butler, & Jellinek, 1987).

Disease staging is a computerized system based on the Uniform Hospital Discharge Data Set (UHDDS) which relies on patterns of diagnoses (Curtin, 1985). Each diagnosis is assigned to one of 400 conditions and to one of four stages. This system defines progressive levels of clinical severity by using the secondary diagnosis to determine a severity level for the principle diagnosis. Because of the way it uses secondary diagnoses, many feel that Disease Staging is more clinically meaningful than DRGs, accounts for disease severity, and is a more appropriate tool for case-mix management than DRGs (Pass, 1987).

The Computerized Severity Index (CSI) is the successor to manual severity of illness indices. Manual systems such as that developed by S. D. Horn used subjective judgements of trained "abstractors" to assess severity levels (Pass, 1987). Other common criticisms of manual systems included their requirement for intensive abstractor training and susceptibility to inappropriate manipulation (Rosko, 1988). CSI uses objective clinical data (such as laboratory test results) to determine a severity level for each coded diagnosis, and then examines the combination of diagnoses to derive an overall severity score.

Patient Management Categories (PMCs) use coded discharge diagnoses to create patient groups. For each of the approximately 800 PMCs, a set of standards for treatment (called a patient management path) is defined. Critics charge that such a system dictates the practice of medicine and stifles new developments (Curtin, 1985). However, because the system is computerized and uses the ICD9 diagnosis and procedure codes, many believe its classifications are more accurate and clinically meaningful than those used by DRGs (Pass, 1987).

The increased availability and use of computers have greatly enhanced the application of patient classification schemes (Giovannetti, 1985). With this enhancement has come new concerns as well. Some common concerns deal with hospital staff resistance to computerized systems, with unanticipated ethical problems, and with the possibility of dehumanizing care (Hylton, Johnson, &

Moran, 1986). The most recent advances in automated classification scheme applications are in the field of expert, or knowledge-based, systems.

Expert Systems Applications to Nursing and Bed Management

Expert systems are a branch of the science of artificial intelligence. They combine expert knowledge contained in a data base with sets of protocols, criteria and rules which replicate the expertise of individuals in specialized fields (Morgan & Slivka, 1988). Unlike conventional computing, data that enters the expert system is not subjected to mathematical formulas as it attempts to direct action based on situational information; heuristic rules limit and direct search activities, making the system more flexible and efficient (Chase, 1988). Expert systems are able to make decisions with uncertain and incomplete information. Another key difference is that expert systems can accept new data, compare it with knowledge already in the system, and modify themselves to account for the new information.

Expert systems offer distinct technological and financial advantages for healthcare applications. Expert systems aid in the development of logically powerful representations for describing medical concepts and facts which serve to support and justify the decision rules commonly used by healthcare professionals (Warner, 1988). They have the flexibility to encourage experimentation with a variety of reasoning methods, which allows users to develop optimized reasoning strategies, and allows them to recover quickly from errors. They provide the potential for tying together all aspects of a patient's healthcare, including medical diagnosis, patient assessment, and nursing management.

There currently are many expert systems dealing with medical diagnosis. Programs such as INTERNIST, Present Illness Program, IRIS, CASNET, and MYCIN are all designed to provide consultative advice in the diagnosis and treatment of diseases. Other programs for specific situations (such as ONCOCIN for Hodgkin's disease patients) are in various stages of development and use.

Current expert system applications in nursing management include the Creighton On-Line Multiple Medical Expert System (COMMES) and the Computer-Aided Nursing Diagnosis and Intervention (CANDI). The Nursing Diagnosis Consultant module of COMMES simulates a professional consultant; it assists with and supports clinical decision making about patient conditions. Nurses can use COMMES as a basis for planning care and determining the staffing and resources required for each type of patient (Ryan, 1985). CANDI shares many of the characteristics found in COMMES, but is divided into an assessment guide and a diagnosis subsystem (Chang, Roth, Gonzales, Caswell, & DiStefano, 1988). Literature discussing the relative effectiveness of these systems was largely unavailable.

Summary

The current status of information technology and advances in automation offer many possible solutions to countless problems including that of efficiently managing bed utilization. Current innovations in healthcare information management include software packages for patient management, patient classification, nursing assessment, and many others. The problems created by the complexity of modern healthcare organizations and the new financial and competitive pressures they face seem to demand innovative, integrated, system-wide answers.

Purpose

The purpose of this project was to develop an automated bed utilization-oriented program for Landstuhl Army Regional Medical Center which would increase the efficiency of bed utilization management efforts. The intent was to design an expert system which combined elements of patient classification, nursing resource management, and bed utilization management techniques. It was intended to increase the coordination between the wards, the nurse supervisors, the Patient Traffic Control Agents, and the admitting physicians within LARMC, and to reduce the man-hours required to implement bed utilization management.

Methods and Procedures

I approached the development of the system in five phases covering a twelve month period. These phases were to be generally unbound by time, and were expected to overlap in some cases. I identified the phases and the schedule for their employment as follows:

Phase I: Assess effectiveness of current system (months 1-4)

Phase II: Assess stakeholder goals for system (months 2-3)

Phase III: Compare current capabilities to goals (months 4-5)

Phase IV: Investigate applicability of available systems (months 1-6)

Phase V: Develop system (months 6-12)

Phase I

I began by assessing the effectiveness and further applicability of the current bed utilization management procedures. I did so by measuring the effectiveness of the current system by both objective and subjective means.

Objective means included measuring the historical frequency of the following inefficiencies: concurrent underutilization and overutilization of wards, uncoordinated admissions, and significant time lags in bed status information. I also measured the man-hours currently dedicated to managing the bed utilization process. I assessed the effectiveness of the current system in subjective terms through personal interviews with key players.

Phase II

During the effectiveness measurement phase, I assessed the stakeholders' goals for the desired bed utilization program. The major internal stakeholders were tentatively identified as: the Commander, the Deputy Commander for Clinical Services (DCCS), the Chief, Department of Medicine, the Chief Nurse, and the head nurse and ward officer from each ward. Once the stakeholders were identified, I used Organizational Development and Strategic Planning techniques in a seminar-type forum to elicit maximum input and response. Using these techniques, I identified the "must have", "want to have", and "nice to have" features of a bed utilization program. From the stakeholders' responses, I developed a detailed listing of functions the program should perform. I identified all inputs and outputs to the system, and identified all users. As the final step in this phase, I obtained consensus on a statement of desired program goals and objectives.

Phase III

Once the first two phases were completed, I compared the current system's capabilities to the desired program goals, and then identified shortfalls and areas of potential improvement. Specifically, I compared the objective and subjective assessments of the current system with the statement of desired program goals and objectives. From this comparison, I then prioritized my attempts to meet the shortfalls in "must have", "want to have", and "nice to have" order.

Phase IV

Concurrently with the first three phases, I investigated the applicability of currently available bed utilization management programs. I identified current initiatives among Army Medical Department (AMEDD) hospitals. Specifically, I reviewed the applicability of the current Automated Quality Control Support System (AQCESS) bed management module, the applicable portions of the Composite Health Care System (CHCS), and the Acuity and Staffing Allocation System prototype written for Brooke Army Medical Center (BAMC) by the Health Care Administration Division of the Academy of Health Sciences. I then identified the desired program goals which could be met by these solutions.

Phase V

As the final phase of the project, I developed an expert system which incorporated applicable portions of current bed utilization management systems and filled the identified shortfalls to accomplish the desired system goals. Using the PROLOG programming language, I developed a system which complemented existing efforts by incorporating all of the "must have" features and most of the other features of the desired system, thus meeting the desired system goals. When the final system was completed, I presented it to the stakeholders for approval, and implemented it on the Commander's order.

I expected the resultant system to meet the goals of the majority of the stakeholders. I expected that, when compared over time to the previous system, use of the expert system would demonstrate greater efficiency in the areas discussed previously: incidence of concurrent underutilization and overutilization of wards, uncoordinated admissions, and significant time lags in bed status information.

Results and Discussion

Phase I

I began my assessment of the effectiveness of LARMC's bed utilization efforts by conducting personal interviews with individual stakeholders. Stakeholders are identified at Appendix

A. I collected information and anecdotes which helped me get a conceptual framework from which to begin. Having completed the interviews, I compiled the information I had received, and designed a survey to capture responses in a more controlled manner (see Appendix B). I used five-point, bipolar rating scales in order to focus respondents' answers into a manageable range, and to aid me in quantifying their responses. The survey also allowed room for additional information where applicable, enabling me to pick up on yet undiscovered trends. I distributed the survey and called a meeting of the stakeholders to discuss responses and identify any additional information. The responses to the survey helped identify objective and subjective measures of effectiveness, and also provided an assessment of system effectiveness using those measures.

Respondents agreed that the following were appropriate measures of bed utilization management effectiveness:

1. The number of staff hours required to find beds for patients.

2. The accuracy and timeliness of bed status information.

3. Full utilization of available nursing staff (not over- or underutilized)

4. The number of problems created by the patient placement decision.

5. The ease of coordination of the placement decision between physician and nursing staffs.

I asked respondents to use these measures to assess system effectiveness over time, asking for an evaluation of the system before any efforts had begun, and for an evaluation of the current efforts. Respondents indicated that the current system had improved slightly since efforts began in August 1990, but was less than moderately effective. Quantification of these and other responses is listed at Appendix C.

The 25 respondents indicated they spent an average of 40 minutes each day managing bed utilization. Translated into man-hours per day, the staff spent approximately 17 man-hours on bed utilization management. This represents a reduction from August, as the respondents reported spending an average of 56 minutes each day, or a total of approximately 24 man-hours per day on the process.

The respondents rated the accuracy and timeliness of bed status information as having improved slightly since August, but as being less than moderately effective. They indicated a slight decrease in the number of problems created by current efforts over previous efforts, but indicated the current system still created problems.

They also indicated an improvement in the ease of coordination of patient placement between the nursing and physician staffs, but indicated that the current process was less than relatively easy.

Concurrent with the survey, I collected WMSN data in an attempt to quantify the number of occurrences of concurrent overutilization and underutilization of nursing staff across wards (see Table 1). I selected a random sample of days, choosing every sixth day from 4 January 1990 to 18 April 1991. This sample offered an equal representation of different days of the week, and covered a wide array of census fluctuations, to include the impact of LARMC support of Operations Desert Shield and Desert Storm, the severe nursing shortage over the summer months of 1990, and the surplus of nursing personnel due to the augmentation of Reservists in support of wartime casualties. I collected SNCH and RNCH figures from the wards supporting the following services: Psychiatry, Pediatrics, Medicine, Neurology, Post Partum, Orthopedics, and Surgery. I considered an incident of concurrent overutilization and underutilization to have occurred on a given sample day when the following occurred:

a.) When any ward reported a surplus of SNCH in excess of 24 hours (1 staff member/day), when there was a total deficit (greater than 24 hours) reported across wards; or, b.) When any ward reported a deficit of SNCH in excess of 24 hours (1 staff member/day), when there was a total surplus (greater than 24 hours) reported across wards.

The data I collected indicated concurrent overutilization and underutilization occurred in 29 of 76 days surveyed, a rate of 38.2 percent. In an attempt to separate the effects of the census fluctuations mentioned above, I segmented the days surveyed into time periods relating to major changes in staffing and/or patient load. This procedure revealed a range of incidence rates from 33.3 percent to 46.2 percent.

In summary, in using the measures of effectiveness agreed upon by the stakeholders, I found that the current bed utilization management efforts had improved slightly, but were less than effective. Although subjective effectiveness measures were used, the data reported and recorded on the two objective effectiveness measures also indicated potential for improvement. The time spent by the stakeholders in managing the process represented 17 man-hours each day, and the incidence rate of concurrent overutilization and underutilization continued to be close to 40 percent.

The assessment of the subjective measures also revealed potential for improvement. There was room to improve the accuracy and timeliness of bed status information, to make coordination of the patient placement decision between the nursing and physician staffs easier, and to reduce the number of problems created by the placement decision.

Phase II

Concurrent with my efforts to assess the effectiveness of current bed utilization efforts, I sought to assess the stakeholder's goals for the system. Following Vroom and Yetton's (1986) Decision Process Flowchart for both Individual and Group Problems and consulting their Decision Making Considerations, I chose to conduct a group decision making session in which I would act as a discussion mediator between the stakeholders. My role would task me to keep the group focused on the problem, and to encourage the participants to offer solutions without restraint or judgement.

I accomplished this by using a survey instrument as tool to guide the discussion. This survey is presented as Appendix D. As in Phase I, I had previously conducted personal interviews with most of the stakeholders, and had included the range of their responses on the survey. During the interviews, a majority of the stakeholders had expressed a desire to see improvement in the patient placement decision making process. They indicated a strong desire to improve the manner in which admitting physicians sought and found appropriate and available beds for their patients. I included goals relating to this popular response in the survey, and included blank space to encourage new responses as well. I asked the stakeholders to list their goals for the bed utilization management system, and by using a rating and ranking technique, asked them to rate each goal as a "must have", "want to have", "nice to have", and "don't need".

The resulting list of goals produced by the stakeholders (see Appendix E) incorporated their emphasis on improving the patient placement decision making process. It also demonstrated their desire to improve the bed utilization management process in terms of the effectiveness measures they had identified earlier.

In response to their emphasis on patient placement decision making, I developed a list of potential data/information elements to be used in that process, and included it in the survey and group decision making session. As with the list of potential goals, I listed responses taken from my personal interviews, included blank space for additional responses, and asked the stakeholders to rank and rate them similarly. I separated the potential data elements into two categories: patient characteristics (see Appendix F) and ward characteristics (see Appendix G).

To complete the discussion, I presented the question of location and control of the bed utilization management system. The group unanimously agreed that, if the proper variables and controls were incorporated, the system should reside under the control of the Patient Administration Division.

By the end of the group decision making session, the stakeholders had agreed that the patient placement decision process was the key to improving bed utilization management. They agreed that by incorporating the data elements listed at Appendices F and G into the decision, and by placing the decision under the Patient Administration Division's control, the goals listed at Appendix E would be achievable.

Patient Placement Decision Support Model

In response to the stakeholders' statement of goals and to their recommendations regarding the patient placement decision making process, I conceptualized a patient placement decision support model. This model would incorporate the patient and ward characteristics identified by the stakeholders (the "experts"), would present those characteristics quickly and accurately to a decision maker, and would assist the decision maker in making an appropriate patient placement decision. The inputs to the model would include the desired patient and ward characteristics. The outputs would include a listing of possible placement locations with an indication of the appropriateness of each ward, and an assessment of current bed status. Admitting physicians would query the model, which would be employed in the Patient Administration

Division. The model would meet the goals listed at Appendix E. The stakeholders unanimously approved of this concept.

Phase III

Having assessed the effectiveness of the current bed utilization management system, and having achieved consensus on a statement of goals for that system, I sought to identify current system successes in meeting those goals and to identify shortfalls and areas for improvement. The actions of the DCCS and the Bed Utilization Committee had improved the bed utilization management system, but had not achieved all of the goals desired by the stakeholders.

The establishment of WMSN data as an official guide to the process, and the establishment of the PTCA as the patient placement decision maker, were critical steps in improving the process. For the first time, consolidated bed information status was presented to a single decision maker, who incorporated nursing resource management information into patient placement decisions, and had the authority to implement those decisions. Taking into account the nature of the patient's injury or illness, the patient's gender, the wards' census and RNCH/SNCH figures, the PTCA made a decision to place the patient in the most appropriate unit.

Recognition of acuity thresholds was also a factor in the process; the PTCA sought to avoid placing any ward in a position where RNCH severely outweighed SNCH.

The procedure made progress toward the established goals of integrating WMSN data, increasing accuracy and timeliness of bed status information, easing the coordination between the nursing and physician staffs, and decreasing the man-hours spent on the process. However, despite taking these positive steps, the system had many deficiencies.

The PTCA got his bed status information from the commanders report, which is a listing of each ward's total census, total RNCH and total SNCH as of 1400 each day. Since the report was prepared only one time each day, it was accurate only one time each day, and got progressively worse with each admission, disposition, and shift change within the hospital. The PTCA had to make up for this inaccuracy by periodically visiting or calling each ward to receive updates. Since the commander's report did not reflect bed availability with regards to gender, nor did it reflect the number of anticipated admissions or discharges for each ward, the PTCA had to collect that information by visiting or calling the ward as well. While this proved to be more accurate than the report alone, Given the possibility of manipulating the system to include WMSN data as search criteria, the CHCS Patient Administration module may very well meet the goals of the stakeholders. However, the proposed fielding schedule and problems in the continued development of the CHCS make this an unattractive option. According to the latest guidance from the Headquarters of 7th Medical Command, LARMC will not receive its first CHCS modules until fiscal year 1993.

UCAPERS Patient Acuity Data Entry Module

The UCAPERS system was designed to collect and report personnel utilization and expense data as well as manpower utilization data. The Patient Acuity Data Entry module, which contains the WMSN module, provides users a tool for patient classification and for determining staffing requirements (Electronic Data Systems Federal Corporation, 1991). This system incorporates data representing many of the patient and ward characteristics desired by the LARMC stakeholders.

The Facility Daily WMSN Report produced under this module has great potential as a patient placement decision support tool. This report combines the following information for each ward in the facility: available beds, current census, total RNCH, total number of admissions and discharges for the day, and the number and type of nursing staff members scheduled. Although the SNCH figure is not given outright, it can be calculated from the figures representing the raw numbers of personnel assigned and the hours they work.

This report format does not contain some of the information deemed important by the LARMC stakeholders. However, it does combine WMSN and census information; an action critical in meeting stakeholder goals. Since this system is currently operating, and since ward staff members currently enter the requisite information therein, adoption of this report as a decision support tool would require little organizational adjustment. However, the data contained in this system is only updated twice each day, which presents potential problems in timeliness and accuracy of bed status information. Additionally, acceptance of this report in its current form would require the stakeholders to operate without much of the information they view as important.

BAMC Acuity and Staffing Allocation System

The Acuity and Staffing Allocation System prototype was developed by the Healthcare Administration Division of the Academy of Health Sciences for application at Brooke Army Medical Center (BAMC), Fort Sam Houston, Texas. It was prompted by conditions very similar to those experienced here at LARMC; lack of coordination in the patient placement decision, and inefficiencies in the bed utilization management process.

Written in the Programming in Logic (PROLOG) artificial intelligence language, the system was designed to maintain bed status information and to assist decision makers in placing patients among BAMC's many wards. The program required wards to input census, RNCH, and SNCH data into a database. The patient administration clerk would query this database each time a patient was admitted, transferred, or discharged. When a new patient was to be admitted, the program would use the information in the database to apply acuity thresholds to the wards and display them to the patient placement decision maker.

The program also contained a module to help the decision maker determine the acuity of the patient about to be admitted. Based on the acuity of the patient and the relative acuity threshold status of each ward, the system would present a choice of wards to which the patient could be admitted. The decision maker could accept or reject the choices the program offered. Once the placement decision was made, the system would automatically update the database with the new information.

Although this model is not directly applicable for use at LARMC, the concepts upon which it was based are very applicable. The availability of timely and accurate bed status information, the integration of WMSN data, and the presentation of a choice of wards based on acuity thresholds and other desired criteria are key components in meeting the LARMC stakeholders' goals. However, in its current form, the system falls short of meeting many of the characteristics and goals desired by the stakeholders. Missing data elements include anticipated length of stay, consideration of whether or not the patient was an anticipated admission, and identification of available beds by gender.

Summary

Of the four initiatives I investigated as potential decision support tools, only the UCAPERS module had immediate applicability. Adoption of this system would require the stakeholders to accept less than their desired goals, but would require little additional efforts to implement. The CHCS module showed the greatest promise in fulfilling the goals of the stakeholders, given the possibility of incorporating WMSN data search criteria. However, the delayed acquisition date conflicted with stakeholder desires for a timely solution. The BAMC prototype, although not directly applicable to LARMC, accentuated the possibility of developing and tailoring a relatively simple decision support model to meet institutional criteria until CHCS is installed and its potential benefits realized.

Phase V

Based on the limited applicability of existing automated systems, I designed a patient placement decision support model specifically tailored to meet the goals of the stakeholders. Using the PROLOG programming language, I designed the program to increase coordination between the ward staffs and the admitting physicians, while decreasing the amount of time spent on the bed utilization management process.

I felt the decision support model needed four components: 1) a database entry function, 2) a patient acuity assessment function, 3) an admission decision support function, and 4) a discharge function. I used a menu-driven approach and maximized the use of "fill in the blanks" data entry in order to make the program "user friendly."

I designed the database entry function to accommodate many of the patient and ward characteristics identified by the stakeholders as important to the patient placement decision. I chose to exclude the ward characteristics dealing with the RNCH of anticipated admissions and discharges. The database created by input through this function provides information to the patient placement decision maker via the admission decision support function. Actions taken by the decision maker in the admission decision support function and the discharge function modify the database appropriately, keeping the information accurate. As the database serves as the representation of real conditions on the wards, it can accommodate periodic updates to fine tune the data. The program allows users to update information on a single ward or all wards, as necessary.

The BAMC Acuity and Staffing Allocation prototype contains a patient acuity assessment module based on the WMSN patient classification system. I found this module to be satisfactory for my purposes, and incorporated it into my program. The module presents questions regarding the type and nature of medical care required by the patient to be admitted, and offers the user menu-style choices for responses. The module computes the responses given, and categorizes the patient into one of the six WMSN categories.

The admission decision support function is the focus of the entire program. It presents the patient placement decision maker with the information necessary to make an informed, appropriate decision, and updates the database based on that decision. In this module, bed status information from the database is combined with an application of WMSN based acuity threshold standards. The resulting status of each ward is presented to the decision maker for consideration. Wards are identified as "open", "warning", or "capped" based on the relationship between RNCH and SNCH.

The module asks for information on the patient about to be admitted, to include anticipated acuity. It then presents information on the status of the wards, and asks for a placement decision. The module allows the decision maker to choose any ward, thus allowing for special considerations and information not captured by the database. Once a ward is selected, the module automatically updates the database to reflect the impact of the new admission on the accepting ward.

The discharge function is relatively simple, but is necessary to keep the database current. When a patient is discharged from the ward, the user makes entries which update the ward's bed status information. This process takes into account the census change and RNCH lost to the discharge, and updates the database accordingly.

Conclusions

The process I followed through the five phases of this project enabled me to achieve my purpose: to develop an automated bed utilization-oriented program for LABMC which would increase the efficiency of bed utilization management efforts. I assessed the effectiveness of the system in place, ascertained the goals of the staff members who had a stake in the process, and compared those goals to the capabilities of the current system and of other applicable systems. I was able to combine concepts from bed utilization management, nursing resource management, patient classification schemes, and expert systems application into the development process. I was able to incorporate expert knowledge into the system, and was able to achieve the goals of the stakeholders.

Achievement of some of the stakeholder goals (see Appendix E) is made possible through the patient decision support model's design. As a single tool for patient placement decision making, consistency in the application of decision variables is achieved (goal 9). The incorporation of RNCH and SNCH, as well as the application of acuity thresholds to the ward status information, integrates WMSN data into the patient placement decision (goal 1). The inclusion of anticipated admissions and discharges as ward characteristics in the database integrates this information into the decision as well (goal 2). The ability to update the database periodically, combined with the automatic updates provided by the admission decision support and discharge functions, increases the accuracy and timeliness of the bed status information (goal 5). Because the model incorporates an accurate database of bed status information, time spent by LARMC staff in collecting that information will be dramatically reduced (goal 7). As the model allows the decision maker to choose any ward regardless of status, special considerations and additional information not captured by the data base are taken into account (goal 10).

Other stakeholder goals can be achieved through appropriate use of the model. As a single repository for bed status information, and as a standardized tool for decision making, the model should increase the coordination between the admitting physicians and the wards regarding patient placement (goal 3). Through the application of the WMSN acuity thresholds and the resulting ward designations of "open", "warning", and "capped" status, the decision maker should be able to make placement decisions which will achieve better nursing staff utilization by reducing the number of incidents of concurrent overutilization and underutilization (goal 4). The communication of information regarding anticipated admissions and discharges required by the model should improve the nursing staff's ability to adjust staffing to meet anticipated demand (goal 8). Adoption of the program as an element of LARMC policy, with full support of the commander and the DCCS, should give authority to the placement decisions produced by the model (goal 6).

Recommendations

Improvement in bed utilization management efficiency at LARMC requires appropriate application of the patient placement decision support model. The model is only a tool. It must be managed for success. Actions at each of the management levels within the system must be taken to ensure the model achieves its intended purpose.

At the ward level, nursing staff members must make an effort to keep the database current. Updating ward status information once per shift was accepted by the stakeholders as a requirement. Ward staff members should also strive to keep their reported RNCH and SNCH data accurate, lending credence to the system and fostering trust in the program. Admitting physicians should increase their communication to the wards. The program requires continual communication regarding anticipated admissions, lengths of stay, and discharges in order to maintain complete and accurate information in the database.

At the nursing supervisor level, verification and enforcement of policies and processes is required. Supervisors can use inter-rater reliability surveys of the WMSN data reported by the wards to keep the data accurate, and to foster trust in the system.

At the DCCS level, adoption of the program as an integral part of LARMC policy is necessary for its success. The WMSN should be emphasized as an appropriate tool in the decision making process, and appropriate acuity thresholds should be set. Designation of the responsibility for the decision maker(s) should take into account the stakeholders' recommendation of the Patient

Administration Division's role, and should provide for appropriate authority behind the decision.

Given the application of these recommendations, the patient placement decision support model I developed should meet the goals of the stakeholders. Accomplishment of these goals should improve the efficiency of the bed utilization management efforts at LARMC.

The process I followed, although specifically tailored for the problems experienced by the LARMC staff, should have applicability in other situations and locations. Identification of stakeholders, inclusion of their expert knowledge in the program, and emphasis on their involvement in its development through group decision making, should improve the chances of success.

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Table 1

Historical Frequency of Concurrent Over- and Underutilization of Wards

	Wards					
	Psychiatry (1D)			Neurology (5D)		
Date	SNCH	RNCH	difference	SNCH	RNCH	difference
Jan 04	71	74	-3	114	171	-57
Jan 10	71	10	61	114	187	-73
Jan 16	71	62	9	114	103	11
Jan 22	71	76	-5	114	68	46
Jan 28	71	98	-27	114	68	46
Feb 02	80	68	12	120	184	-64
Feb 08	80	98	-18	123	163	-40
Feb 14	80	84	-4	123	144	-21
Feb 21	80	200	-120	123	170	-47
Feb 26	80	111	-31	123	132	-9
Mar 03	80	111	-31	123	90	33
Mar 09	80	90	-10	123	101	22
Mar 15	80	84	-4	123	148	-25
Mar 21	80	136	-56	123	141	-18
Mar 27	80	79	1	123	147	-24
Apr 02	89	80	9	64	123	-59
Apr 08	78	96	-18	64	142	-78
Apr 21	78	78	0	80	138	-58
Apr 27	84	171	-87	128	194	-66
May 03	94	156	-62	128	167	-39
May 09	94	124	-30	120	153	-33
May 15	86	221	-135	136	199	-63
May 22	84	88	-4	128	126	2
May 27	78	106	-28	64	28	36
Jun 01	88	142	-54	112	87	25
Jun 09	72	109	-37	88	145	-57
Jun 13	102	98	4	72	193	-121
Jun 19	88	68	20	112	118	-6
Jun 25	88	81	7	80	35	45
Jul 01	72	46	26	64	37	27
Jul 07	72	84	-12	80	103	-23
Jul 13	116	132	-16	112	77	35
Jul 19	108	37	71	128	121	7
Jul 25	88	115	-27	96	130	-34
Jul 31	112	68	44	112	124	-12
Aug 06	104	81	23	88	109	-21
Aug 12	72	70	2	64	124	-60
Aug 25	72	69	3	64	59	5
Aug 31	80	40	40	96	147	-51

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Wards							
Pediatrics (3C)			Post Partum (7D)			Medicine	
SNCH	RNCH	difference	SNCH	RNCH	difference	SNCH	RNCH
100	114	-14	71	74	-3	100	96
100	36	64	71	24	47	100	178
100	146	-46	71	30	41	100	132
100	97	3	71	97	-26	100	117
100	215	-115	71	64	7	100	129
103	86	17	80	86	-6	103	152
103	222	-119	80	62	18	103	104
103	152	-49	80	69	11	103	145
103	119	-16	80	89	-9	103	148
103	72	31	80	67	13	103	97
103	88	15	80	42	38	103	117
103	109	-6	80	60	20	103	137
103	88	15	80	57	23	103	102
103	169	-66	80	30	50	103	129
103	139	-36	80	83	-3	103	129
72	79	-7	56	148	-92	64	109
72	48	24	64	56	8	84	90
80	138	-58	56	93	-37	72	85
88	122	-34	80	103	-23	138	109
104	21	83	64	145	-81	124	94
112	115	-3	80	47	33	125	98
88	76	12	80	66	14	128	85
96	69	27	80	26	54	128	108
85	62	23	56	28	28	65	61
80	93	-13	72	67	5	136	129
56	81	-25	64	120	-56	116	115
72	117	-45	80	100	-20	128	168
96	132	-36	82	20	62	133	176
82	81	1	88	115	-27	112	109
80	41	39	72	118	-46	72	61
56	36	20	56	20	36	72	134
80	119	-39	64	56	8	116	119
96	162	-66	56	63	-7	134	140
96	97	-1	56	57	-1	93	110
80	101	-21	80	64	16	104	70
64	181	-117	59	58	1	120	76
48	84	-36	48	57	-9	64	71
72	128	-56	56	52	4	64	111
48	62	-14	80	133	-53	112	156

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	Wards						
(5B)	Orthopedics (10CD)			Surgery (14CD)		
difference	SNCH	RNCH	difference	SNCH	RNCH	difference
4	105	150	-45	105	92	13
-78	105	183	-78	105	240	-135
-32	105	183	-78	105	137	-32
-17	105	93	12	105	87	18
-29	105	88	17	105	135	-30
-49	97	253	-156	103	205	-102
-1	97	254	-157	103	193	-90
-42	97	158	-61	103	259	-156
-45	97	185	-88	103	100	3
6	97	103	-6	103	112	-9
-14	97	187	-90	103	254	-151
-34	97	184	-87	103	141	-38
1	97	190	-93	103	203	-100
-26	97	181	-84	103	122	-19
-26	97	188	-91	103	223	-120
-45	64	202	-138	72	160	-88
-6	64	122	-58	72	135	-63
-13	80	265	-185	96	175	-79
29	136	217	-81	128	233	-105
30	163	179	-16	120	137	-17
27	120	181	-61	112	125	-13
43	136	226	-90	128	159	-31
20	136	168	-32	112	145	-33
4	64	135	-71	72	99	-27
7	136	180	-44	104	201	-97
1	56	167	-111	96	289	-193
-40	128	115	13	128	160	-32
-43	112	120	-8	120	105	15
3	112	101	11	128	151	-23
11	56	75	-19	80	159	-79
-62	64	82	-18	84	125	-41
-3	112	132	-20	136	177	-41
-6	96	159	-63	160	166	-6
-17	80	155	-75	112	180	-68
34	112	179	-67	136	164	-28
44	96	103	-7	120	123	-3
-7	72	116	-44	80	138	-58
-47	72	99	-27	88	72	16
-44	112	162	-50	104	155	-51

Wards			
TOTALS			
SNCH	RNCH	DIFFERENCE	AVERAGE DIFFERENCE
666	771	-105	-15
666	858	-192	-27
666	793	-127	-18
666	635	31	4
666	797	-131	-19
686	1034	-348	-50
689	1096	-407	-58
689	1011	-322	-46
689	1011	-322	-46
689	694	-5	-1
689	889	-200	-29
689	822	-133	-19
689	872	-183	-26
689	908	-219	-31
689	988	-299	-43
481	901	-420	-60
498	689	-191	-27
542	972	-430	-61
782	1149	-367	-52
797	899	-102	-15
763	843	-80	-11
782	1032	-250	-36
764	730	34	5
484	519	-35	-5
728	899	-171	-24
548	1026	-478	-68
710	951	-241	-34
743	739	4	1
690	673	17	2
496	537	-41	-6
484	584	-100	-14
736	812	-76	-11
778	848	-70	-10
621	844	-223	-32
736	770	-34	-5
651	731	-80	-11
448	660	-212	-30
488	590	-102	-15
632	855	-223	-32

Sep 06	72	44	28	104	111	-7
Sep 12	88	81	7	88	147	-59
Sep 18	92	90	2	120	156	-36
Sep 24	88	53	35	88	70	18
Sep 30	88	9	79	65	83	-18
Oct 05	84	20	64	104	101	3
Oct 11	84	54	30	112	132	-20
Oct 17	68	47	21	132	140	-8
Oct 23	80	64	16	144	192	-48
Oct 29	68	51	17	120	116	4
Nov 03	80	54	26	96	166	-70
Nov 09	96	102	-6	104	118	-14
Nov 16	88	41	47	104	215	-111
Nov 21	88	46	42	120	144	-24
Nov 27	84	81	3	128	162	-34
Dec 05	84	57	27	80	131	-51
Dec 09	72	68	4	64	118	-54
Dec 22	72	61	11	80	188	-108
Dec 28	80	128	-48	96	138	-42
Jan 03	92	129	-37	160	138	22
Jan 09	80	90	-10	136	134	2
Jan 15	80	108	-28	128	164	-36
Average	83	86	-3	106	130	-25

*************************** Operation Desert Storm Expansion ***************************

	Psychiatry (1D)			Neurology (5D)		
Date	SNCH	RNCH	difference	SNCH	RNCH	difference
Jan 21	132	61	71	156	68	88
Jan 27	96	27	69	108	30	78
Feb 02	92	89	3	216	77	139
Feb 08	112	44	68	112	33	79
Feb 14	104	56	48	176	133	33
Feb 19	124	113	11	136	109	27
Feb 26	128	69	59	180	139	41
Mar 04	108	52	56	136	183	-47
Mar 10	72	42	30	168	144	24
Mar 23	96	86	10	106	99	7
Mar 29	100	104	-4	182	170	12
Apr 04	100	91	9	228	174	54
Apr 10	108	90	18	196	151	45
Apr 16	100	64	36	208	193	15
APR 18	100	132	-32	220	172	48
Average	105	75	30	169	125	43
Overall Average	94	80	14	137	128	9

SNCH = Supportable Nursing Care Hours
RNCH = Required Nursing Care Hours

104	131	-27	80	94	-14	106	157
80	65	15	80	88	-8	104	121
80	66	14	56	50	6	112	230
72	70	2	48	42	6	104	167
60	100	-40	48	42	6	72	116
72	115	-43	80	42	38	112	162
72	103	-31	72	46	26	130	188
80	99	-19	64	92	-28	90	168
96	73	23	80	52	28	126	186
96	95	1	64	46	18	136	142
72	151	-79	48	80	-32	72	112
64	86	-22	64	37	27	124	105
100	59	41	64	88	-24	118	173
72	69	3	56	83	-27	120	160
96	97	-1	80	106	-26	136	149
80	79	1	80	32	48	128	207
72	59	13	48	72	-24	64	136
72	120	-48	56	99	-43	72	120
80	32	48	64	25	39	120	122
88	86	2	56	113	-57	117	107
88	119	-31	56	91	-35	144	143
84	107	-23	72	86	-14	108	142
85	100	-14	69	70	-1	106	128

************************************ Operation Desert Storm Expansion ******************

Pediatrics (3C)			Post Partum (7D)			Medicine	
SNCH	RNCH	difference	SNCH	RNCH	difference	SNCH	RNCH
0	0	0	0	0	0	0	0
78	2	76	84	5	79	128	24
0	0	0	96	83	13	180	5
0	0	0	84	63	21	104	0
0	0	0	56	85	-29	120	11
84	57	27	96	71	25	104	10
108	0	108	172	78	94	88	5
64	84	-20	128	26	102	68	31
108	70	38	80	36	44	144	294
84	99	-15	96	44	52	80	38
96	140	-44	120	30	90	260	142
115	100	15	96	60	36	178	115
112	110	2	128	47	81	264	171
132	56	76	88	68	20	192	196
128	88	40	104	101	3	144	226
74	54	20	95	53	42	137	85
80	77	3	82	61	21	121	106

6 of 8

-51	104	201	-97	120	180	-60
-17	112	158	-46	100	200	-100
-118	120	254	-134	116	150	-34
-63	128	142	-14	75	195	-120
-44	72	147	-75	96	97	-1
-50	112	159	-47	144	153	-9
-58	128	197	-69	150	166	-16
-78	96	186	-90	102	131	-29
-60	120	162	-42	144	178	-34
-6	120	120	0	144	150	-6
-40	72	131	-59	102	159	-57
19	104	154	-50	132	177	-45
-55	96	147	-51	132	201	-69
-40	104	187	-83	120	159	-39
-13	112	142	-30	96	179	-83
-79	112	168	-56	108	178	-70
-72	56	150	-94	72	243	-171
-48	72	123	-51	84	162	-78
-2	112	113	-1	120	115	5
10	120	166	-46	108	155	-47
1	112	119	-7	108	118	-10
-34	80	127	-47	192	131	61
-22	101	159	-58	110	161	-51

************************************ Operation Desert Storm Expansion ******************

(5B)	Orthopedics (10CD)			Surgery (14CD)		
difference	SNCH	RNCH	difference	SNCH	RNCH	difference
0	168	80	88	96	44	52
104	80	93	-13	96	10	86
175	64	64	0	88	19	69
104	108	53	55	176	20	156
109	240	172	68	72	49	23
94	196	144	52	176	32	144
83	192	104	88	240	64	176
37	228	295	-67	192	146	46
-150	108	60	48	168	152	16
42	184	217	-33	276	140	136
118	167	118	49	304	273	31
63	248	228	20	458	123	335
93	328	231	97	240	310	-70
-4	252	241	11	160	165	-5
-82	148	183	-35	338	163	175
52	181	152	29	205	114	91
15	141	155	-15	158	137	20

690	918	-228	-33
652	860	-208	-30
696	996	-300	-43
603	739	-136	-19
501	594	-93	-13
708	752	-44	-6
748	886	-138	-20
632	863	-231	-33
790	907	-117	-17
748	720	28	4
542	853	-311	-44
688	779	-91	-13
702	924	-222	-32
680	848	-168	-24
732	916	-184	-26
672	852	-180	-26
448	846	-398	-57
508	873	-365	-52
672	673	-1	-0
741	894	-153	-22
724	814	-90	-13
744	865	-121	-17
659	833	-174	-25

*** Operation Desert Storm Expansion *****

TOTALS			
SNCH	RNCH	DIFFERENCE	AVERAGE DIFFERENCE
552	253	299	37
670	191	479	60
736	337	399	50
696	213	483	60
768	506	262	33
916	536	380	48
1108	459	649	81
924	817	107	13
848	798	50	6
922	723	199	25
1229	977	252	32
1423	891	532	67
1376	1110	266	33
1132	983	149	19
1182	1065	117	15
965	657	308	39
812	745	67	7

Appendix A

Stakeholders

Deputy Commander for Clinical Services

Chief, Department of Medicine

Chief, Department of Nursing

Chief, Department of Surgery

Chief, Department of OB/GYN

Chief, Department of Pediatrics

Chief, Department of Psychiatry

Nursing Supervisors:

- Child and Maternal Health
- Medical
- Surgical
- Nights and Evenings

Head Nurses:

Ward 1D	Psychiatry
Ward 5D	Neurology
Ward 6D	Pediatrics
Ward 7D	Post Partum
Ward 8D	Medicine
Ward 10CD	Orthopedics
Ward 11B	Orthopedics Convalescence
Ward 14CD	General Surgery/Thoracic Surgery

Appendix B

Survey Instrument

This is a survey designed to collect your impressions of the effectiveness of LARMC bed utilization management efforts, and to gain your input on the proposed goals and objectives of the system. When completed, this process will result in the formulation of LARMC bed utilization policy. Please bring this survey to the bed utilization meeting, or return it to CPT SHAUL, Administrative Resident/DCA office 486-8105/8199.

PLEASE FILL IN THE BLANKS OR CIRCLE YOUR CHOICE, AS APPROPRIATE. PLEASE RESPOND TO ALL QUESTIONS. THANK YOU. CPT Shaul, Administrative Resident

1. What is your name/rank?

2. What is your position in LARMC?

   a. Chief, Department of________________________
   b. Nursing Supervisor__________________________section.
   c. PTCA
   d. Head Nurse__________________________________ward.
   e. Other_______________________________________

3. Below is a partial list of potential MEASURES of bed utilization MANAGEMENT EFFECTIVENESS. Add those measures you feel need to be included. Rate your completed list of measures on the following scale:

A = Very important	B = somewhat important	C = minimally important	D = not important

________ Number of staff hours required to find beds for patients
________ Accuracy and timeliness of bed status information
________ Full utilization of nursing staff available (not over/underutilized)
________ Number of problems created by the placement decision
________ Ease of coordination of the placement decision between physician and nursing staffs

____
____
____

4. Please answer the following questions relating to the effectiveness measures listed above:

A. How do you rate the effectiveness of our bed utilization management efforts **BEFORE** the changes (10 August and later, see attached review) took effect?

very ----- somewhat ----- neutral---- moderately ----- very
ineffective ineffective effective effective

B. How do you rate the **CURRENT** effectiveness of our bed utilization management efforts?

very ----- somewhat --- neutral----- moderately ----- very
ineffective ineffective effective effective

C. How much of your time **EACH DAY** was spent trying to find beds for patients **BEFORE** the changes took effect (10 August)?

(in hours) 0---.5---1---1.5---2---2.5---3---3.5---4 or more

D. How much of your time **EACH DAY** is spent trying to find beds for patients under the **CURRENT** system?

(in hours) 0---.5---1---1.5---2---2.5---3---3.5---4 or more

E. How did you get your bed status information **BEFORE** the changes (10 August) took effect?

a. paper form (e.g., morning report)
b. by phone calls
c. by walking around
d. a and b only
e. a and c only
f. b and c only
g. all three

F. How do you get your bed status information **NOW**?

_________(a through g as above)

G. How accurate was the bed status information you received **BEFORE** the changes (10 August) took effect?

very inaccurate ---- somewhat inaccurate ---- don't know ---- moderately accurate ---- very accurate

H. How accurate is the bed status information you receive **NOW**?

very inaccurate ---- somewhat inaccurate ---- don't know ---- moderately accurate ---- very accurate

I. How many problems were created by the bed utilization management "system" **BEFORE** the changes (10 August) took effect?

considerably many ---- many ---- few ---- negligible ---- none

J. How many problems are created under the **CURRENT** system?

considerably many ---- many ---- few ---- negligible ---- none

K. How easy was it to coordinate between the physician and nursing staffs to place patients on wards **BEFORE** the changes (10 August) took effect?

considerably difficult ---- moderately difficult ---- neither easy nor difficult ---- relatively easy ---- very easy

L. How easy is it **NOW** to coordinate between the physician and nursing staffs to place patients on wards?

considerably difficult ---- moderately difficult ---- neither easy nor difficult ---- relatively easy ---- very easy

Appendix C

Quantification of Survey Responses

Total System Effectiveness:

Weight distribution:

very ineffective	somewhat ineffective	neutral	moderately effective	very effective
(-2)	(-1)	(0)	(+1)	(+2)

Results (sum of weighted responses divided by number of responses):
Before current efforts: -.04
Current efforts: 0.42

Time Spent Collecting Bed Status Information:

Results:	Total Time Spent	Average time/Respondent
Before current efforts:	23.5 hours/day	0.94 hours/day
Current efforts:	16.5 hours/day	0.67 hours/day

Method Used to Collect Bed Status Information:

Method Used	Before Current Efforts	Current Efforts
Paper only	0	1
Phone only	5	8
Walking around only	2	2
Paper and phone only	1	1
Paper and walking around only	1	2
Phone and walking around only	6	2
All three	12	11

Accuracy of Bed Status Information:

Weight distribution:

very inaccurate	somewhat inaccurate	don't know	moderately accurate	very accurate
(-2)	(-1)	(0)	(+1)	(+2)

Results (sum of weighted responses divided by number of responses):
Before current efforts: 0.22
Current efforts: 0.7

<u>Number of Problems:</u>

Weight Distribution:

considerably many	----	many	----	few	----	negligible	----	none
(-4)		(-3)		(-2)		(-1)		(0)

Results (sum of weighted responses divided by number of responses):
Before current efforts: -2.50
Current efforts: -2.07

<u>Ease of Coordination of Patient Placement:</u>

Weight Distribution:

considerably difficult	----	moderately difficult	----	neither easy nor difficult	----	relatively easy	----	very easy
(-2)		(-1)		(0)		(+1)		(+2)

Results (sum of weighted responses divided by number of responses):
Before current efforts: -0.04
Current efforts: 0.52

Appendix D

Survey of Stakeholder Goals

The following is a partial list of **POTENTIAL GOALS** for the bed utilization management system. Add those goals which you feel need to be included. Rate each goal as follows:

A = Must have it
B = Want to have it
C = Nice to have it
D = Don't need it

________ 1. Integrate WMSN data (RNCH and SNCH) into the patient placement decision.

________ 2. Integrate anticipated admissions and anticipated discharges (over the following 24 hours) into the patient placement decision.

________ 3. Reduce the number of man-hours spent by PTCAs, Nursing supervisors, and Head nurses in deciding where to place patients and managing this process.

________ 4. Increase the coordination between admitting physicians, nursing supervisors, and wards regarding patient placement.

________ 5. Achieve better utilization of nursing staff/available bed space by reducing the differences (both over- and underutilization) between RNCH and SNCH.

________ 6. Increase the timeliness of bed status information. Arm the patient placement decision maker with "real-time" information.

________ 7. Achieve enough lead time on bed status information to enable the nursing staff to adjust staffing to anticipated demand.

________ 8. Achieve consistency in the application of decision variables towards the patient placement decision.

________ 9. Invest the decision maker with enough authority to make his/her decision stick.

________ 10. Allow for overrides for special considerations (and to minimize Risk Management issues).

________ 12.

________ 13.

________ 14.

________ 15.

The following are partial lists of **POTENTIAL DATA/INFORMATION ELEMENTS**
which could be included in a patient placement decision support model. Add those data/information elements you feel need to be included. Rate each element as follows:

A = Must have it
B = Want to have it
C = Nice to have it
D = Don't need it

A. Integrate the following **PATIENT CHARACTERISTICS** into the patient placement decision:

________ 1. Admitting service
________ 2. Gender
________ 3. Anticipated acuity
________ 4. Admission status (anticipated or unanticipated)
________ 5. Special requirements (VIP, isolation, specific ward)
________ 6.
________ 7.
________ 8.
________ 9.
________ 10.

B. Integrate the following **WARD CHARACTERISTICS** into the patient placement decision:

_______ 1. Area of expertise (e.g. Medical, Ortho, Psych)
_______ 2. Total beds available
_______ 3. Male, Female, and Nonspecific beds available
_______ 4. Total census
_______ 5. Male, Female census specified
_______ 6. Anticipated admissions (total) in next 24 hours
_______ 7. Anticipated Male, Female admissions in next 24 hours
_______ 8. Anticipated discharges (total) in next 24 hours
_______ 9. Anticipated Male, Female discharges in next 24 hours
_______ 10. Current RNCH
_______ 11. RNCH of anticipated admissions (total)
_______ 12. RNCH of anticipated Male, Female admissions
_______ 13. RNCH of anticipated discharges (total)
_______ 14. RNCH of anticipated Male, Female discharges
_______ 15. Current SNCH
_______ 16.
_______ 17.
_______ 18.
_______ 19.
_______ 20.
_______ 21.
_______ 22.
_______ 23.
_______ 24.
_______ 25.

Appendix E

Stakeholder Goals

The list of "must have" goals included the following:

1. Integrate Workload Management System for Nursing data (RNCH and SNCH) into the patient placement decision.
2. Integrate anticipated admissions and discharges (over the following 24 hours) into the patient placement decision.
3. Increase the coordination between the admitting physicians, nursing supervisors, and wards regarding patient placement.
4. Achieve better utilization of nursing staff by reducing the incidents of concurrent overutilization and underutilization (as previously defined).
5. Increase the accuracy and timeliness of bed status information. Arm the patient placement decision maker with "real-time" information.
6. Invest the patient placement decision maker with enough authority to make his/her decision stick.

The list of "want to have" goals included the following:

7. Reduce the number of manhours spent by Patient Traffic Control Agents (PTCAs), nursing supervisors, and head nurses in managing this process.

8. Achieve enough lead time on bed status information to enable the nursing staff to adjust staffing to anticipated demand.
9. Achieve consistency in the application of decision variables in the patient placement decision.
10. Allow for overrides of the placement decision for special considerations (and to minimize risk management issues).

The stakeholders ranking of the above goals left none in the "nice to have" or "don't need" categories.

Appendix F

Desired Patient Characteristics

The stakeholders identified the following patient characteristics as "must have" data elements:

1. The service responsible for the patient as dictated by the nature of the illness or injury (e.g. Orthopedics, Pediatrics, Neurology).
2. The patient's gender.
3. The anticipated acuity of the patient.
4. Whether or not the patient was an anticipated/scheduled admission.
5. Special requirements such as isolation.

The following were listed as "want to have" data elements:

6. Anticipated length of stay.
7. Whether or not the patient was admitted only to await further medical evacuation.
8. Whether or not the patient was being transferred within the hospital.

The age of the patient was considered a "nice to have" data element.

Appendix G

Desired Ward Characteristics

The stakeholders identified the following ward characteristics as "must have" data elements:

1. The service or area of expertise the ward supported (e.g. Orthopedics, Pediatrics, Neurology).
2. The total number of beds available.
3. The number of male, female, and non-specific beds available.
4. The total census on the ward.
5. The male and female census on the ward.
6. The anticipated admissions in the next 24 hours.
7. The anticipated discharges in the next 24 hours.
8. The current number of nursing care hours required by patients on the ward (RNCH).
9. The current number of nursing care hours available from the staff supporting the ward (SNCH).

The stakeholders identified the following ward characteristics as "want to have" data elements:

10. The anticipated male and female admissions in the next 24 hours.

11. The anticipated male and female discharges in the next 24 hours.

12. The RNCH of anticipated admissions in the next 24 hours.

The stakeholders identified the following ward characteristics as "nice to have" data elements:

13. The RNCH of anticipated male admissions and female admissions in the next 24 hours.

14. The RNCH of anticipated discharges in the next 24 hours.

15. The RNCH of anticipated male discharges and female discharges in the next 24 hours.

Appendix H

Comparison Matrix

	Current	AQCESS	CHCS	UCAPERS	BAMC
"Must Have" Goals					
1. Integrate WMSN	yes	no	no	yes	yes
2. Anticipated Admits/Discharges	no	no	no	no	no
3. Increase Coordination	yes	?	?	?	?
4. Better Nurse Utilization	no	?	?	?	?
5. Accuracy, Timeliness	yes	?	?	?	?
6. Authority to Decision Maker	yes	?	?	?	?
"Want to Have" Goals					
7. Reduce Manhours	yes	?	?	?	?
8. Lead Time	no	?	?	?	?
9. Consistency	no	?	?	?	?
10. Overrides Possible	yes	yes	yes	yes	yes
"Must Have" Patient Characteristics					
1. Area of Concentration	yes	yes	yes	yes	yes
2. Gender	yes	yes	yes	yes	yes
3. Anticipated Acuity	no	no	no	yes	yes
4. Scheduled Admission?	yes	no	yes	no	no
5. Special Requirements	yes	yes	yes	yes	no
"Want to Have" Pt. Characteristics					
6. Anticipated Length of Stay	no	no	no	no	no
7. Medevac Status	yes	no	no	no	no
8. In-house Transfer	yes	yes	yes	yes	yes
"Must Have" Ward Characteristics					
1. Area of Concentration	yes	yes	yes	yes	yes
2. Total Beds Available	yes	yes	yes	yes	yes
3. Available Beds by Gender	no	no	yes	no	no
4. Total Census	yes	yes	yes	yes	yes
5. Census by Gender	no	no	yes	no	no
6. Anticipated Admissions	no	no	no	no	no
7. Anticipated Discharges	no	no	no	no	no
8. Current RNCH	yes	no	no	yes	yes
9. Current SNCH	yes	no	no	yes	yes
"Want to Have" Ward Characteristics					
10. Anticip. Admits by Gender	no	no	no	no	no
11. Anticipated DCs by Gender	no	no	no	no	no
12. RNCH of Anticipated Admits	no	no	no	no	no
"Nice to Have" Ward Characteristics					
13. RNCH of Ant. Admits/Gender	no	no	no	no	no
14. RNCH of Anticipated DCs	no	no	no	no	no
15. RNCH of Ant. DCs by Gender	no	no	no	no	no